

What is claimed is:

1. A ventilation support monitoring method for a ventilator supplying a breathing gas to a patient via a breathing circuit in fluid communication with at least one lung of the patient, the ventilator having a plurality of selectable ventilator setting controls for governing supply of the breathing gas from the ventilator to the patient, each setting control selectable to a level setting, comprising:

receiving at least one ventilator setting parameter signal, each ventilator setting parameter signal indicative of the level setting of one ventilator setting control;

monitoring a plurality of sensors to determine the sufficiency of ventilation support supplied to the patient, each sensor operatively connected to a select one of the patient or the breathing circuit, each sensor generating an output signal; and

determining the desired level setting of at least one ventilator setting control of the ventilator.

2. The method of Claim 1, wherein the output signals are selected from the group comprising: an exhaled carbon dioxide signal indicative of the exhaled carbon dioxide (ExCO₂) level of the exhaled gas expired by the patient within the breathing circuit; a flow rate signal indicative of the flow rate (V) of the inhaled/exhaled gas expired by patient within the breathing circuit; a pulse oximeter hemoglobin oxygen saturation (SpO₂) signal indicative of the oxygen saturation level of the patient; a pressure (P) signal indicative of the pressure of the breathing gas within the breathing circuit; a blood pressure (BP) signal indicative of the blood pressure of the patient; and a temperature (T) signal indicative of the core body temperature of the patient.

3. The method of Claim 2, wherein the output signals also comprise at least one of: an arterial blood gas PaO₂ signal; an arterial blood gas PaCO₂ signal; and an arterial blood gas pH signal.

[illegible]

claim 1, further comprising displaying the desired level setting controls.

claim 1, wherein determining the desired level settings of the further comprises generating ventilation data from the sensing subsystem.

claim 7, wherein the processing subsystem has a neural determining the desired level settings of the ventilator setting further comprises applying at least a portion of the ventilator setting parameter signal to the neural network of the

claim 1, wherein determining the desired level settings of the further comprises generating ventilation data from the sensing subsystem.

claim 7, wherein the processing subsystem has a neural determining the desired level settings of the ventilator setting further comprises applying at least a portion of the ventilator setting parameter signal to the neural network of the

claim 7, wherein the processing subsystem has a neural
determining the desired level settings of the ventilator setting
further comprises applying at least a portion of the
ventilator setting parameter signal to the neural network of the

8. The method of Claim 7, wherein the processing subsystem has a neural network, and wherein determining the desired level settings of the ventilator setting controls of the ventilator further comprises applying at least a portion of the ventilation data and the ventilator setting parameter signal to the neural network of the

processing subsystem to determine the desired level settings of the ventilator setting controls.

9. The method of Claim 7, wherein the processing subsystem has a neural network, and wherein the step of determining the desired level settings of the ventilator setting controls further comprises:

applying a set of decision rules to at least a portion of the ventilation data and the ventilator setting parameter signal to classify a portion of the ventilation data and the ventilator setting parameter signal;

applying a portion of the ventilation data and the ventilator setting parameter signal to the neural network; and

determining at least one desired level settings of the ventilator setting controls of the ventilator from the applied portion of the ventilation data and the ventilator setting parameter signal.

10. A method for differential determination of a plurality of desired level settings of a ventilator having selectable ventilator setting controls, each setting control selectable to a level setting, the method comprising:

supplying a breathing gas from the ventilator to a patient via a breathing circuit in fluid communication with the ventilator and at least one lung of the patient;

receiving a plurality of output signals indicative of the physiological characteristics of the patient and the characteristics of the breathing gas supplied to the patient;

receiving a plurality of ventilator setting parameter signals indicative of the level settings of the ventilator setting controls;

deriving a plurality of ventilation data from the output signals;

selecting at least a portion of the ventilation data and at least a portion of the ventilator setting parameter signals;

converting the selected portion of the ventilation data and the selected portion of the ventilator setting parameter signals into numerical expressions;

inputting a plurality of the transformed numerical expressions into a neural network; and

determining at least one of the desired level settings of the ventilator setting controls using the neural network in accordance with the input numerical expressions.

11. The method of Claim 10, further comprising training the neural network to determine each of the desired level settings of the ventilator setting controls using the ventilation data and the ventilator setting parameter signals.

12. The method of Claim 11, further comprising dividing the determination of the desired level settings of the ventilator setting controls into a plurality of stages using a plurality of neural networks.

13. The method of Claim 11, wherein the neural network includes a plurality of parallel neural networks, each of the parallel neural networks having a plurality of inputs and one output, the outputs respectively corresponding to the plurality of setting controls, so that one output corresponds to one desired level setting of one ventilator setting control.

14. The method of Claim 10, wherein deriving the ventilation data comprises deriving a plurality of: pressure (P) of the breathing gas within the breathing circuit; flow rate (V) of the breathing gas within the breathing circuit; exhaled carbon dioxide (ExCO₂) in the breathing gas within the breathing circuit; peak inflation pressure (PIP); mean airway pressure (Paw); positive end expiratory pressure (PEEP); continuous positive airway pressure (CPAP); breathing frequency (f); tidal volume (V_T); minute exhaled ventilation (V_E); inhalation-to-exhalation time ratio (I:E); physiological dead space volume (V_{dphys}); lung carbon dioxide elimination rate (LCO₂); partial pressure end-tidal carbon dioxide (PetCO₂); respiratory muscle

SECRET

1
 2
 3
 4
 5
 6
 7
 8
 9
 10
 11
 12
 13
 14
 15
 16
 17
 18
 19
 20
 21
 22
 23
 24
 25
 26
 27
 28
 29
 30
 31
 32
 33
 34
 35
 36
 37
 38
 39
 40
 41
 42
 43
 44
 45
 46
 47
 48
 49
 50
 51
 52
 53
 54
 55
 56
 57
 58
 59
 60
 61
 62
 63
 64
 65
 66
 67
 68
 69
 70
 71
 72
 73
 74
 75
 76
 77
 78
 79
 80
 81
 82
 83
 84
 85
 86
 87
 88
 89
 90
 91
 92
 93
 94
 95
 96
 97
 98
 99
 100
 101
 102
 103
 104
 105
 106
 107
 108
 109
 110
 111
 112
 113
 114
 115
 116
 117
 118
 119
 120
 121
 122
 123
 124
 125
 126
 127
 128
 129
 130
 131
 132
 133
 134
 135
 136
 137
 138
 139
 140
 141
 142
 143
 144
 145
 146
 147
 148
 149
 150
 151
 152
 153
 154
 155
 156
 157
 158
 159
 160
 161
 162
 163
 164
 165
 166
 167
 168
 169
 170
 171
 172
 173
 174
 175
 176
 177
 178
 179
 180
 181
 182
 183
 184
 185
 186
 187
 188
 189
 190
 191
 192
 193
 194
 195
 196
 197
 198
 199
 200
 201
 202
 203
 204
 205
 206
 207
 208
 209
 210
 211
 212
 213
 214
 215
 216
 217
 218
 219
 220
 221
 222
 223
 224
 225
 226
 227
 228
 229
 230
 231
 232
 233
 234
 235
 236
 237
 238
 239
 240
 241
 242
 243
 244
 245
 246
 247
 248
 249
 250
 251
 252
 253
 254
 255
 256
 257
 258
 259
 260
 261
 262
 263
 264
 265
 266
 267
 268
 269
 270
 271
 272
 273
 274
 275
 276
 277
 278
 279
 280
 281
 282
 283
 284
 285
 286
 287
 288
 289
 290
 291
 292
 293
 294
 295
 296
 297
 298
 299
 300
 301
 302
 303
 304
 305
 306
 307
 308
 309
 310
 311
 312
 313
 314
 315
 316
 317
 318
 319
 320
 321
 322
 323
 324
 325
 326
 327
 328
 329
 330
 331
 332
 333
 334
 335
 336
 337
 338
 339
 340
 341
 342
 343
 344
 345
 346
 347
 348
 349
 350
 351
 352
 353
 354
 355
 356
 357
 358
 359
 360
 361
 362
 363
 364
 365
 366
 367
 368
 369
 370
 371
 372
 373
 374
 375
 376
 377
 378
 379
 380
 381
 382
 383
 384
 385
 386
 387
 388
 389
 390
 391
 392
 393
 394
 395
 396
 397
 398
 399
 400
 401
 402
 403
 404
 405
 406
 407
 408
 409
 410
 411
 412
 413
 414
 415
 416
 417
 418
 419
 420
 421
 422
 423
 424
 425
 426
 427
 428
 429
 430
 431
 432
 433
 434
 435
 436
 437
 438
 439
 440
 441
 442
 443
 444
 445
 446
 447
 448
 449
 450
 451
 452
 453
 454
 455
 456
 457
 458
 459
 460
 461
 462
 463
 464
 465
 466
 467
 468
 469
 470
 471
 472
 473
 474
 475
 476
 477
 478
 479
 480
 481
 482
 483
 484
 485
 486
 487
 488
 489
 490
 491
 492
 493
 494
 495
 496
 497
 498
 499
 500
 501
 502
 503
 504
 505
 506
 507
 508
 509
 510
 511
 512
 513
 514
 515
 516
 517
 518
 519
 520
 521
 522
 523
 524
 525

16. The method of Claim 10, wherein the neural network comprises a plurality of input units, a plurality of hidden layers having a plurality of hidden units, and a plurality of output units, the output units respectively corresponding to the plurality of ventilator settings.

18. The method of Claim 10, further comprising displaying at least one of the plurality of desired level settings for the ventilator setting controls of the ventilator.

a processing subsystem connected to receive the output signals from the sensors and the ventilator setting parameter signal from the input, the processing subsystem having a processor and a memory, the processor running under control of a program stored in the memory, the processing subsystem having an intelligence system to determine a desired level setting of at least one ventilator setting control in response to the ventilator setting parameter signal and the output signals.

21. The system of Claim 20, wherein the means the plurality of ventilation support parameters also includes at least one of: the arterial blood gas PaO₂ level of the

1. The first group of people who are interested in the study of the history of the world are the historians. They are the people who study the past and try to understand what happened and why it happened. They use a variety of sources, including books, documents, and artifacts, to reconstruct the past.

23. The system of Claim 19, further comprising a display, wherein the processing subsystem provides the desired level settings of the ventilator setting controls to the display.

24. The ventilator of Claim 19, further comprising an alarm for notifying an operator of the ventilator that the level settings of the ventilator setting controls differs from the determined desired level settings of the ventilator setting controls.

25. The system of Claim 19, wherein the desired level setting for the ventilator setting control of the ventilator comprises at least one of: a minute ventilation (V_E) level indicative of the desired V_E level to set on the ventilator; a ventilator breathing frequency (f) level indicative of the desired f level to set on the ventilator; a tidal volume (V_T) level indicative of the V_T level to set on the ventilator; a breathing gas flow rate (V) level indicative of the V level to set on the ventilator; a pressure limit

SECRET

the processing subsystem has at least one neural network ; and
the processor, in determining the desired level settings of the ventilator setting controls, generates a plurality of ventilation data from the output signals of the sensors and applies at least a portion of the ventilation data and at least a portion of the ventilator setting parameter signal to the neural network to generate the desired level settings of the ventilator setting controls.

27. The system of Claim 26, wherein the processing subsystem is programmed with a set of decision rules and wherein the processor applies the set of decision rules to the ventilation data prior to applying the portion of the ventilation data and the portion of the ventilator setting parameter signal to the neural network.

28. The system of Claim 26, further comprising a display, wherein the processing subsystem identifies ventilation data used to determine the desired level settings of the ventilator setting controls, identifies a subset of the ventilation data for display, and provides the subset of the ventilation data to the display, and wherein the processing subsystem provides the desired level settings of the ventilator setting controls to the display.

means for inputting a plurality of the transformed numerical expression into the neural network so that the desired level settings of the ventilator setting controls are determined in accordance with the input numerical expressions.

means for training the neural network using the statistically significant training data sets so that the desired level settings of the ventilator setting controls are determined based upon selected output signals and selected level settings of the ventilator setting controls.

31. ~~A ventilation support monitoring system for a ventilator supplying a breathing gas to a patient via a breathing circuit in fluid communication with at least one lung of~~

THE NEW YORK PUBLIC LIBRARY

a processor having a memory, the processor connected to receive output signals from the sensors and the ventilator setting parameter signals from the input and running under control of a program stored in the memory to generate a plurality of ventilation data from the output signals, to apply at least a portion of the ventilation data and at least a portion of the ventilator setting parameter signals to the neural network to determine the desired level settings of the ventilator setting controls.

32. The system of Claim 31, wherein the plurality of ventilation support parameters comprises one or more of: the flow rate (V) of the exhaled gas inspired/expired by patient within the breathing circuit; the exhaled carbon dioxide (ExCO₂) level of the exhaled gas expired by the patient within the breathing circuit; the hemoglobin oxygen saturation (SpO₂) level of the patient; the pressure of the breathing gas within the breathing circuit; the blood pressure (BP) of the patient; and the core body temperature (T) of the patient.

1966-1967 and 1967-1968 in that they made their trip

33. The system of Claim 34, further comprising a display, wherein the processing subsystem provides the desired level settings of the ventilator setting controls to the display.

34. The system of Claim 31, wherein the desired level settings for the ventilator setting controls include at least one of the group comprising: a minute ventilation (V_E) level indicative of the desired V_E level to set on the ventilator; a ventilator breathing frequency (f) level indicative of the desired f level to set on the ventilator; a tidal volume (V_T) level indicative of the V_T level to set on the ventilator; a breathing gas flow rate (V) level indicative of the V level to set on the ventilator; a pressure limit level indicative of the pressure limit level to set on the ventilator; a work of breathing (WOB) level indicative of the WOB level to set on the ventilator; a pressure support ventilation (PSV) level indicative of the PSV level to set on the ventilator; a positive end expiratory pressure (PEEP) level indicative of the PEEP level to set on the ventilator; a continuous positive airway pressure (CPAP) level indicative of the CPAP level to set on the ventilator; and a fractional inhaled oxygen concentration (FIO2) level indicative of the FIO2 level to set on the ventilator.

35. The system of Claim 31, wherein the processor is programmed with a set of decision rules and wherein the processor applies the set of decision rules to the ventilation data prior to applying the portion of the ventilation data and the portion of the ventilator setting parameter signal to the neural network.

36. The system of Claim 33, wherein the processing subsystem identifies ventilation data used to determine the desired level settings of the ventilator setting controls; identifies a subset of the ventilation data for display; and provides the subset of the ventilation data to the display.

37. The system of Claim 31, wherein the processing subsystem has means for training the neural network.

38. The ventilator of Claim 31, further comprising:
an alarm signal produced by the processing subsystem when at least one level setting of the ventilator setting control differs from the desired level setting for that ventilator setting control; and
one or more of an audible and visible alert in response to the alarm signal to alert the operator.

Ad BH

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60
61	62	63	64	65
66	67	68	69	70
71	72	73	74	75
76	77	78	79	80
81	82	83	84	85
86	87	88	89	90
91	92	93	94	95
96	97	98	99	100
101	102	103	104	105
106	107	108	109	110
111	112	113	114	115
116	117	118	119	120
121	122	123	124	125
126	127	128	129	130
131	132	133	134	135
136	137	138	139	140
141	142	143	144	145
146	147	148	149	150
151	152	153	154	155
156	157	158	159	160
161	162	163	164	165
166	167	168	169	170
171	172	173	174	175
176	177	178	179	180
181	182	183	184	185
186	187	188	189	190
191	192	193	194	195
196	197	198	199	200
201	202	203	204	205
206	207	208	209	210
211	212	213	214	215
216	217	218	219	220
221	222	223	224	225
226	227	228	229	230
231	232	233	234	235
236	237	238	239	240
241	242	243	244	245
246	247	248	249	250
251	252	253	254	255
256	257	258	259	260
261	262	263	264	265
266	267	268	269	270
271	272	273	274	275
276	277	278	279	280
281	282	283	284	285
286	287	288	289	290
291	292	293	294	295
296	297	298	299	300
301	302	303	304	305
306	307	308	309	310
311	312	313	314	315
316	317	318	319	320
321	322	323	324	325
326	327	328	329	330
331	332	333	334	335
336	337	338	339	340
341	342	343	344	345
346	347	348	349	350
351	352	353	354	355
356	357	358	359	360
361	362	363	364	365
366	367	368	369	370
371	372	373	374	375
376	377	378	379	380
381	382	383	384	385
386	387	388	389	390
391	392	393	394	395
396	397	398	399	400
401	402	403	404	405
406	407	408	409	410
411	412	413	414	415
416	417	418	419	420
421	422	423	424	425
426	427	428	429	430
431	432	433	434	435
436	437	438	439	440
441	442	443	444	445
446	447	448	449	450
451	452	453	454	455
456	457	458	459	460
461	462	463	464	465
466	4			